

LUMBER GRADE RECOVERY IN A CIRCULAR-SAW MILL IN CALIFORNIA¹

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HIGH PRICES for lumber have prevailed since early in World War II. Because of this, many circular-saw mills have been established in California, drawing their logs largely from areas where, in the past, stands were considered unattractive for cutting because of the size or inferior quality of the timber.

This study presents, first, the grade recovery from ponderosa and sugar pine of the thrifty and mature classes typical of much of the Sierra pine region immediately above the foothill belt. Grade recovery from second-growth pine was to have been the subject originally; but in June, 1949, when the study was initiated, a slump in the market halted the cutting of this class of material.

Second, the study involves grade recovery, overrun, and sawing practices of a circular-saw mill in the Sierra pine region, that is considerably better built and more efficiently operated than the average of this type. The only existing information in this field in California is a study made in 1933 that shows grade recovery for entire trees from virgin forests, as sawed by a large band mill.³

The present work represents the first study in which grade recovery of ponderosa and sugar pine has been worked out on the basis of log grades. The results will, of course, be inapplicable to band mills and to other types of timber. Nevertheless the characteristic types of grade recovery from different log grades are indicated.

The graphic results, as presented in figures 1 and 2, must not be taken too literally. The study was relatively limited, and the statistical base is narrow. For this reason the basic data (tables 1 to 15) are presented so that irregularities of values can be appreciated, and the accuracy of the resulting curves will not be overestimated.

STUDY PROCEDURE

The logs were scaled on the mill deck by the company scaler, and only the net scale was recorded. One member of the study crew compared these net

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³ Brundage, M. R., M. E. Krueger, and Duncan Dunning. The economic significance of tree size in western Sierra lumbering. Calif. Agr. Exp. Sta. Bul. 549. 1933.

scales immediately with the values of the Scribner decimal C log rule. Where gross scale differed from the net, that was also recorded.

Grading on the mill deck was made according to the six log grades as defined in 1938 by the Pacific Northwest Forest and Range Experiment Station. A copy of this log-grading system is on the last page of this study. Log number, species, and grade were recorded on suitable forms.

The cost of milling logs varies directly with the time of sawing on the head-saw. Times were recorded to the nearest hundredth of a minute. It was found on completion of the study that the delay items were negligible. The sawing times shown in tables 1 and 2 contain these delays prorated to each log diameter class.

Each board was marked on the trimmer table with a designation of the log as well as of the board. For example, the mark 284/17 on a board indicated that it was board no. 17 from log no. 284.

One member of the study crew recorded board numbers and green grades as established by the company grader. Originally the study was to be of fall-down in grade due to seasoning. But since the green-chain grader was not certified, while the man grading the seasoned lumber was, any differences between green and dry grades are largely differences between graders and have no relation to degrade due to seasoning.

Finally, the boards were recorded by their dry grades as they were taken out of the piles in the dry yard.

VOLUME OF TIMBER IN THE STUDY

Table 3 shows that, for each log grade, the study involved approximately equal numbers of ponderosa and sugar pine logs, and that the logs in each species were of approximately equal average diameter. The average log volumes for the two species differ by only 2 board feet.

RELATION OF LUMBER GRADES TO LOG GRADES

These figures (tables 4 to 15) and the graphs derived from them (figs. 1 and 2) show what every experienced mill-man knows: (1) that the selects come almost wholly from grade 1 logs; (2) that the shop grades (including moulding) come mostly from the large logs of grades 1, 2, and 3; and (3) that the common grades are sawed largely from small logs of nearly all grades.

In this study the lumber yield of the various grades was similar for both sugar pine and ponderosa pine, although significant differences exist that will be noted later. But taking the two species together, certain well-defined correlations are evident between grades of logs and the grades of lumber sawed from them.

The selects come principally from medium-sized, grade 1 logs (about 32 inches in diameter). Logs under 25 and over 40 inches yield distinctly less. The yield to the top grade—B and better—never exceeds 10 per cent of the grade 1 logs. As the log grades decrease, the yield of selects drops rapidly—B and better falling to a negligible percentage in grade 3, and even D select being scarcely represented in grade 4.

Shop grades (including moulding) are more closely correlated with log size than with log grade until the inferior grade 5 logs are encountered,

because 40-inch logs yield approximately 50 to 60 per cent of shop grades regardless of log grade. Similarly, 20-inch logs of grades 1, 2, and 3 all yield from 25 to 35 per cent of shop grades. The no. 2 shop makes up the greatest proportion of logs in general, although in larger logs the proportion of moulding (including no. 3 clear) is relatively high, particularly in log class 1.

The common grades come from small logs. In the first three log classes at 20-inch diameters, yield of common lumber is about 50 to 60 per cent, in smaller logs still higher. For example, in sugar pine grade 2 logs, for which data down to 14-inch diameters are available, common lumber totals nearly 90 per cent. In log grades 4 and 5, which have very little shop and select lumber, the percentage of common is still higher—about 80 per cent for 20-inch logs.

Within the common grades of lumber, no. 1 common is small in amount and is absent or insignificant in quantity in large logs. The very low-class grades 4 and 5 are also relatively small in amount, averaging about 5 per cent and showing little tendency to change consistently with changes in log grade or size. The bulk of the common lumber falls into grades 2 and 3, with grade 2 definitely exceeding grade 3. No. 1 and No. 2 common, in each species, make up better than 60 per cent of the common grades.

DIFFERENCES IN GRADE YIELD

The differences in grade yield are generally small between logs of sugar and ponderosa pine of the same grade. Differences that appear may be greatly influenced by the fact that relatively small samples were available, and by the sawing policy at this mill.

In *log grade 1* (tables 4 and 5), the yield of B and better and of C select appears to be definitely better in ponderosa pine than in sugar pine. On the other hand, the yield of sugar pine moulding grade is somewhat better. In shop and common grades, differences do not appear significant.

The yield of selects in ponderosa pine increases with log size in *log grade 2* (tables 6 and 7) up to the limits of the data. Sugar pine, on the other hand, shows the best yield at about 25-inch diameters, with a sharp decrease beyond, especially in D selects. This constitutes the only notable difference between the two species in this grade.

In *log grade 3* (tables 8 and 9) the two species are in striking accord.

Log grade 4 (tables 10 and 11) contains a much wider range of diameters in sugar pine than in ponderosa, but, within the zone common to both, little difference exists except that in ponderosa pine there is about three times as much no. 2 common lumber as no. 3; while in sugar pine, the no. 2 common is only about one and one-half times as great as the no. 3.

In the small, inferior logs making up *log grade 5* (tables 12 and 13), there are no essential differences between the two species.

In general, the grades secured from ponderosa pine at this mill appear to run slightly better than those from sugar pine of the same log grades (tables 14 and 15). In view of the small number of samples and the fact that sawing policies and local variations in the nature of timber defects greatly affect the yield of grades, no statistical analysis of significance of differences has been made.

OVERRUN

Overrun for ponderosa pine and sugar pine combined is shown by figure 3. This indicates that an inserted-tooth circular saw with its wide kerf produces an underrun for logs between 25 inches and 43 inches in diameter.

ACKNOWLEDGMENTS

Mr. Delbert Schiffner, President and Manager of the Grizzly Creek Sawmill at Nevada City, California, permitted this study to be made at his plant. Every member of his organization coöperated to the fullest possible extent.

Mr. DeWitt Nelson, State Forester of California, furnished the services of Mr. Deane Bennett, who helped in the mill phases of the study.

Mr. Silas B. Carr, then (1949) a senior in forestry, assisted in the study for both the mill and calculating phases.

Thanks are gratefully extended to all.

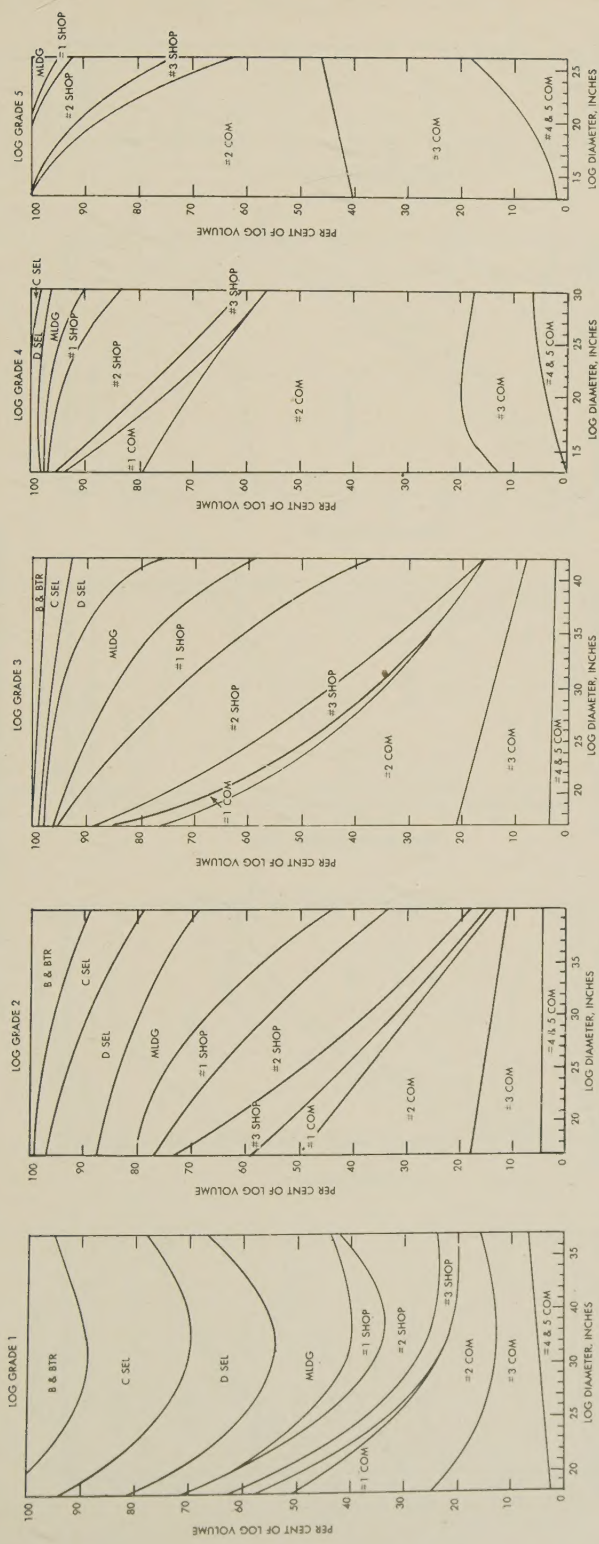


Figure 1—Lumber Grade Recovery, Ponderosa Pine

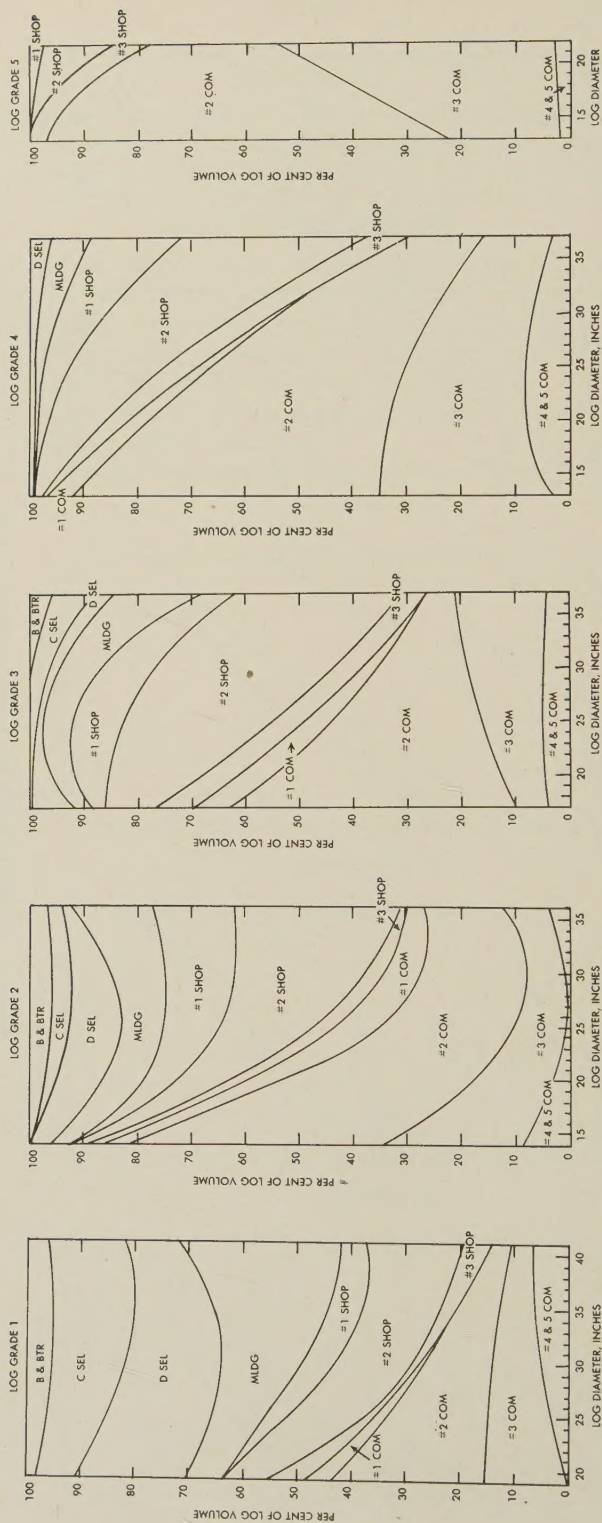


Figure 2—Lumber Grade Recovery, Sugar Pine

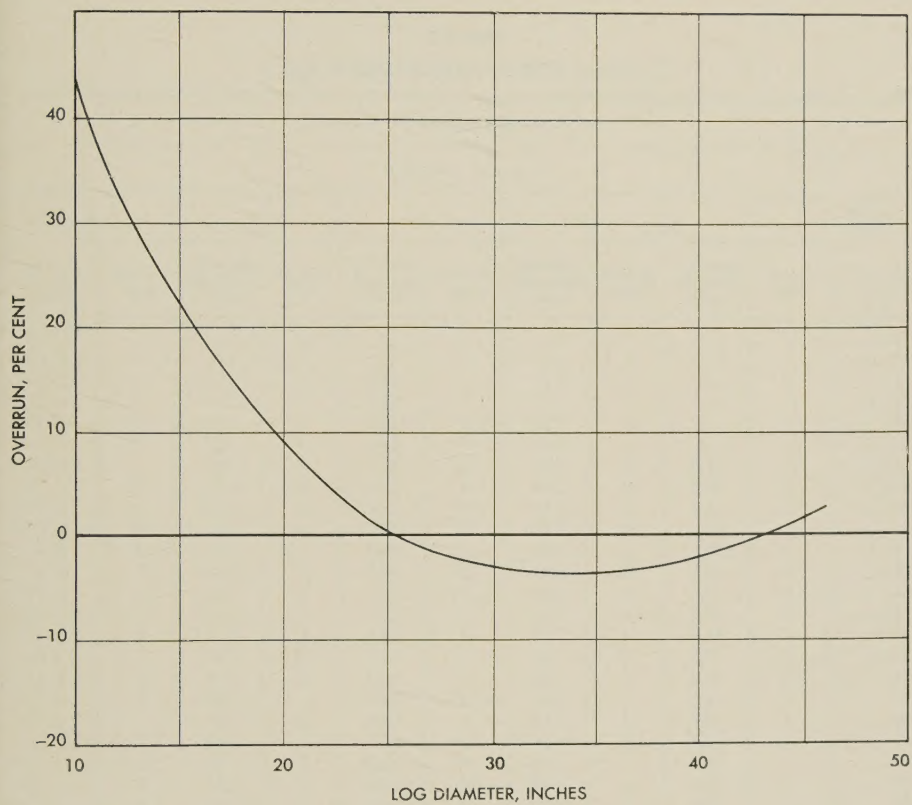


Figure 3—Overrun Curve

TABLE 1
SAWING TIME—PONDEROSA PINE

Diam. of log (inches)	Sawing time per M feet									
	Log grade									
	1		2		3		4		5	
	No. of logs	Sawing time/M (min.)	No. of logs	Sawing time/M (min.)	No. of logs	Sawing time/M (min.)	No. of logs	Sawing time/M (min.)	No. of logs	Sawing time/M (min.)
12.....	..	....	..	....	..	....	2	14.8	..	17.9
13.....	..	....	..	....	..	....	3	14.1	2	16.5
14.....	..	....	..	....	..	14.3	1	13.5	..	15.4
15.....	..	....	..	....	1	13.5	7	13.0	2	14.4
16.....	..	....	..	....	1	13.0	5	12.4	2	13.6
17.....	..	....	..	12.6	3	12.3	7	12.0	2	12.9
18.....	..	14.5	1	12.1	4	11.7	7	11.6	..	12.2
19.....	2	14.2	2	11.8	8	11.2	4	11.2	2	11.7
20.....	1	13.7	2	11.4	8	10.8	2	11.0	2	11.3
21.....	..	13.2	2	11.0	9	10.5	1	10.7	1	10.9
22.....	4	12.7	..	10.7	6	10.2	3	10.3	1	10.5
23.....	2	12.2	3	10.3	9	10.0	1	10.0	..	10.3
24.....	3	11.8	2	10.0	7	9.9	2	9.8	..	10.0
25.....	5	11.3	2	9.7	7	9.7	1	9.4	1	10.0
26.....	2	10.8	2	9.4	3	9.6	..	9.2	1	9.8
27.....	5	10.5	2	9.1	5	9.5	1	8.9	..	9.6
28.....	6	10.2	2	9.0	1	9.4	1	8.7	..	9.3
29.....	1	9.9	..	8.9	4	9.4	..	8.3	..	9.1
30.....	3	9.7	2	8.8	..	9.3	2	8.0	..	9.0
31.....	3	9.5	2	8.7	2	9.3	..	7.7	..	..
32.....	3	9.5	..	8.6	5	9.2	..	7.4	..	..
33.....	1	9.4	1	8.5	2	9.2	..	..	..	..
34.....	..	9.5	1	8.3	1	9.2	..	..	..	..
35.....	2	9.5	..	8.2	..	9.1	..	..	..	..
36.....	2	9.6	..	8.1	1	9.1	..	..	..	..
37.....	1	9.9	..	8.0	..	9.0	..	..	..	..
38.....	3	10.3	1	8.0	..	8.9	..	..	..	..
39.....	..	10.8	..	7.9	..	8.8	..	..	..	..
40.....	..	11.3	2	7.7	..	8.7	..	..	..	..
41.....	..	12.1	..	7.6	..	8.6	..	..	..	..
42.....	1	13.1	..	..	1	8.5	..	..	..	..
43.....	..	14.3	..	..	..	8.4	..	..	..	..
44.....	1	15.7	..	..	..	..	..	..	..	..

TABLE 2
SAWING TIME—SUGAR PINE

Diam. of log (inches)	Sawing time per M feet									
	Log grade									
	1		2		3		4		5	
	No. of logs	Sawing time/M (min.)	No. of logs	Sawing time/M (min.)	No. of logs	Sawing time/M (min.)	No. of logs	Sawing time/M (min.)	No. of logs	Sawing time/M (min.)
12.....	..	....	..	....	..	....	1	14.8	1	14.9
13.....	..	....	..	14.1	..	14.8	4	14.2	..	14.3
14.....	..	....	1	13.8	..	14.3	3	13.6	2	13.7
15.....	..	....	..	13.3	1	13.6	8	13.0	2	13.2
16.....	..	....	..	12.9	2	13.2	10	12.4	5	12.6
17.....	..	....	..	12.4	5	12.6	4	11.9	4	12.1
18.....	..	16.7	..	12.0	3	12.2	14	11.3	4	11.5
19.....	2	16.0	2	11.7	6	11.7	9	10.9	3	11.2
20.....	1	15.3	2	11.3	10	11.3	4	10.5	1	10.5
21.....	2	14.7	2	10.9	10	10.9	5	10.2	1	10.2
22.....	5	14.0	..	10.6	4	10.4	4	9.8	1	9.9
23.....	2	13.3	3	10.1	5	10.1	1	9.5	1	9.5
24.....	1	12.8	3	9.8	12	9.8	4	9.1	..	9.2
25.....	1	12.2	3	9.5	10	9.5	1	8.9	..	9.1
26.....	1	11.8	4	9.2	9	9.3	..	8.6	..	..
27.....	2	11.3	3	8.9	7	9.1	..	8.3	..	..
28.....	3	11.0	2	8.6	8	9.0	1	8.1	..	..
29.....	5	10.6	2	8.3	6	9.0	..	8.0	..	..
30.....	..	10.3	2	8.1	7	8.9	..	8.0	..	..
31.....	1	10.1	1	8.0	3	9.0	..	7.9	..	..
32.....	6	10.0	4	8.0	3	9.1	..	7.9	..	..
33.....	1	10.0	2	8.0	2	9.3	..	8.0	..	..
34.....	6	10.0	2	8.0	..	9.6	..	8.1	..	..
35.....	2	9.9	2	8.1	..	....	..	8.3	..	..
36.....	1	9.9	..	8.3	..	....	..	8.7	..	..
37.....	3	10.0	1	8.7	..	....	1	9.0	..	..
38.....	2	10.1	..	9.0	..	....	..	9.6	..	..
39.....	1	10.3	..	....	..	....	..	....	..	..
40.....	..	10.7	..	....	..	....	..	....	..	..
41.....	..	11.1	..	....	..	....	..	....	..	..
42.....	1	11.6	..	....	..	....	..	....	..	..
43.....	..	12.2	..	....	..	....	..	....	..	..
44.....	..	....	..	....	..	....	..	....	..	..

TABLE 3
VOLUMES INVOLVED IN STUDY

Species	Log grade	Number of logs	Total volume (bd. ft.)	Volume per log (bd. ft.)
Ponderosa pine.....	1	64	39,301	614
	2	45	22,039	490
	3	114	51,897	455
	4	65	16,450	253
	5	18	4,726	262
Total.....		306	134,413	439
Sugar pine.....	1	63	40,633	645
	2	49	27,095	553
	3	124	54,639	441
	4	79	21,400	271
	5	29	6,493	224
Total.....		344	150,260	437
Grand total.....		650	284,673	876

TABLE 4
PER CENT GRADE RECOVERY—DRY LUMBER GRADE BASIS
PONDEROSA PINE—LOG GRADE 1

Diameter of log (inches)	No. of logs	Selects and better			Mldng.	3 Ctr.	Shop			Common				
		B and better	C	D			1	2	3	1	2	3	4	5
19.....	2	.....	14.13	15.26	10.22	.....	.....	10.02	3.72	5.02	41.63	.....	.....	.....
20.....	1	.....	10.42	23.44	.....	.....	.....	24.44	.....	.....	.....	41.70	.....	.....
21.....	1	12.36	.....	10.11	34.85	.....	.....	.....	6.74	.....	17.97	.....	.....	.....
22.....	4	.84	9.80	18.41	18.33	.....	.....	2.87	3.97	2.70	16.21	16.98	6.17	3.72
23.....	3	6.47	13.22	14.65	5.22	.....	4.49	6.82	.....	8.62	25.15	12.93	2.43	.....
24.....	4	1.37	6.30	16.16	22.85	1.64	5.27	10.40	8.35	.....	18.62	8.70	.34	.....
25.....	4	10.78	10.57	21.19	7.65	.44	5.68	10.96	5.18	3.52	17.85	6.18	.....	.....
26.....	3	6.42	19.81	7.19	13.73	.....	3.64	5.52	10.75	.....	23.20	9.33	.41	.....
27.....	5	6.75	17.64	15.55	17.83	.94	3.78	7.74	4.68	.....	18.72	3.66	2.71	.....
28.....	6	14.50	16.59	21.27	14.38	.69	3.22	6.03	1.16	.....	8.48	9.03	4.17	.48
29.....	2	11.17	19.08	15.40	18.60	.....	5.74	7.53	2.45	.....	12.04	2.54	5.45	.....
30.....	3	10.82	27.01	9.02	25.60	1.61	.88	6.34	4.97	.....	4.09	6.78	2.88	.....
31.....	4	9.68	11.07	18.73	10.58	1.74	8.95	9.46	2.65	.47	12.03	13.88	.76	.....
32.....	5	15.70	26.89	13.07	8.65	.....	5.48	8.91	3.03	.....	5.54	6.80	4.82	1.11
33.....	1	.....	17.11	4.03	17.74	.....	7.54	23.76	.....	.....	20.14	6.67	1.38	.....
34.....	2	18.28	21.24	11.99	20.45	.....	.62	4.66	1.93	1.63	1.00	3.29	16.54	.....
35.....	4	7.17	14.32	18.06	17.38	.....	4.55	15.24	2.82	.90	15.64	1.21	2.71	.....
36.....	2	9.73	26.08	12.44	22.05	.....	28	3.60	.34	.....	19.85	5.63	.....	.....
37.....	1	.....	3.98	17.25	12.27	.....	17.78	33.26	.....	.....	6.18	9.28	.....	.....
38.....	4	13.57	14.96	13.25	15.04	2.07	3.43	9.83	4.85	.....	4.34	9.61	8.55	.40
39.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
40.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
41.....	1	13.73	12.27	8.30	34.73	.....	1.88	7.52	6.08	.....	.....	.55	14.94	.....
42.....	1	.....	10.50	24.54	14.02	.....	2.16	24.02	2.48	.....	.....	9.46	12.82	.....
43.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
44.....	1	2.82	33.11	9.42	32.23	.....	1.85	5.45	4.57	.....	.....	.....	2.10	8.45

TABLE 5
PER CENT GRADE RECOVERY—DRY LUMBER GRADE BASIS
SUGAR PINE—LOG GRADE 1

Diameter of log (inches)	No. of logs	Selects and better				Midg.	3 Ctr.	Shop			Common				
		B and better	C	D	1			2	3	1	2	3	4	5	
19.....	2	2.59	8.15	13.14	12.23	....	....	8.15	6.67	5.93	28.33	14.81	....	....
20.....	1	2.10	....	19.58	5.60	....	....	9.79	13.99	....	....	20.27	28.67	....
21.....	2	.93	10.20	19.17	4.64	....	....	12.05	9.28	....	....	9.90	....	....
22.....	5	2.46	20.64	15.96	13.02	....	....	1.84	2.64	1.96	18.92	8.87	1.10	....
23.....	2	3.64	14.08	25.48	3.49	....	....	6.80	6.64	....	17.10	22.77	....	....
24.....	2	1.99	18.23	21.04	10.74	....	....	....	2.34	....	20.55	....	3.74	....
25.....	2	1.55	6.98	16.42	7.09	....	....	8.43	19.29	1.77	31.26	....	....	....
26.....	1	1.98	13.52	21.08	7.95	....	....	3.38	17.29	....	23.07	11.73	....	....
27.....	2	....	6.48	26.56	9.67	....	....	7.33	12.30	....	30.05	3.76	.38	....
28.....	2	5.77	9.43	13.24	17.22	....	....	....	.85	....	5.97	11.17	6.44	3.73
29.....	7	3.71	16.42	13.88	18.46	....	....	3.87	12.91	1.74	18.25	7.57	2.74	....
30.....	..	....	....	....	....	....	....	....	....	....	....	....	....	....
31.....	2	3.19	11.17	10.36	26.81	....	....	4.64	18.04	1.74	11.73	9.64	2.32	.36
32.....	9	7.85	9.05	11.05	17.86	.17	....	9.42	18.46	1.20	16.37	4.57	2.00	....
33.....	5	4.34	10.93	12.98	15.65	.41	....	4.57	16.10	8.00	4.06	11.97	10.23	.76
34.....	8	7.68	18.41	10.14	24.56	....	....	5.70	8.69	3.79	7.92	8.69	3.98	....
35.....	3	6.11	13.27	13.01	16.17	.41	....	11.36	17.50	1.66	12.26	2.53	3.53	.98
36.....	1	5.30	23.72	17.16	24.33	....	....	1.38	2.52	3.03	....	3.40	19.16	....
37.....	3	1.21	15.10	10.55	29.70	1.21	....	9.42	11.56	5.88	3.91	6.30	4.61	.55
38.....	2	12.25	16.44	7.73	18.86	....	....	10.04	11.59	4.02	12.88	6.19	....	....
39.....	..	....	....	....	....	....	....	....	....	....	....	....	....	....
40.....	1	6.69	21.90	6.38	41.05	....	....	1.54	6.46	4.92	7.37	3.69	....	....
41.....	..	....	....	....	....	....	....	....	....	....	....	....	....	....
42.....	1	....	....	12.82	25.38	....	....	8.11	30.84	5.99	2.26	4.52	8.46	1.62

TABLE 6
PER CENT GRADE RECOVERY—DRY LUMBER GRADE BASIS
PONDEROSA PINE—LOG GRADE 2

Diameter of log (inches)	No. of logs	Selects and better			Midng.	3 Ctr.	Shop			Common				
		B and better	C	D			1	2	3	1	2	3	4	5
15.....	2	.....	.....	12.96	4.45	.....	.....	.....	21.46	.....	6.48	17.00	16.61	21.04
16.....	..	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
17.....	..	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
18.....	3	2.93	3.52	9.82	6.60	.....	7.62	3.67	9.82	.....	.....	20.23	2.49	.....
19.....	2	.....	3.42	6.20	4.91	.....	2.13	11.95	6.42	.....	33.30	8.97	12.63	.....
20.....	3	.....	3.87	9.93	6.42	.....	.....	8.24	9.21	.....	43.37	29.41	.....	.....
21.....	3	.....	6.12	16.12	14.28	.....	.....	10.92	5.92	6.53	32.92	.....	.....	.....
22.....	2	9.00	.....	4.98	8.35	3.86	7.72	10.94	4.34	.....	28.06	3.27	4.39	4.39
23.....	3	.49	11.32	6.15	8.69	.....	2.61	20.50	9.83	18.36	22.66	14.64	10.13	3.38
24.....	2	.....	2.76	12.51	11.87	.....	3.38	19.83	.64	3.39	17.06	4.58	.85	.41
25.....	3	4.63	4.71	5.36	3.76	.80	11.46	30.20	2.76	6.96	19.72	6.16	3.48	.....
26.....	3	5.94	2.18	13.80	9.76	2.46	9.01	18.76	2.94	.....	26.63	8.46	.....	.....
27.....	3	3.96	1.83	6.16	10.86	.....	6.77	18.32	17.33	.....	20.13	6.83	7.81	.....
28.....	3	.92	6.33	5.00	10.47	1.38	13.92	22.95	2.87	.....	22.07	13.63	.46	.....
29.....	..	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
30.....	3	6.39	6.28	7.04	15.69	.....	8.54	11.87	6.23	3.17	18.34	14.35	2.10	.....
31.....	3	3.26	10.42	7.58	16.27	.....	12.00	22.51	1.78	3.42	10.76	12.00	.....	.....
32.....	1	.....	6.27	6.27	5.64	.....	25.71	26.32	6.27	.....	5.01	11.76	6.75	.....
33.....	2	18.17	3.95	4.87	13.57	3.29	10.60	9.74	5.66	.....	18.23	11.92	.....	.....
34.....	2	2.45	5.45	12.66	8.23	2.72	6.80	24.70	4.90	.54	17.07	4.15	10.33	.....
35.....	..	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
36.....	..	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
37.....	..	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
38.....	..	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
39.....	..	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
40.....	2	10.19	9.75	9.44	21.50	4.43	11.88	15.60	.35	.....	2.83	7.66	6.37	.....

TABLE 7
PER CENT GRADE RECOVERY—DRY LUMBER GRADE BASIS
SUGAR PINE—LOG GRADE 2

Diameter of log (inches)	No. of logs	Selects and better			Midg.	3 Clr.	Shop			Common				
		B and better	C	D			1	2	3	1	2	3	4	5
14.....	1	.....	.....	4.86	3.47	.....	.....	.....	.....	.....	14.57	72.24	4.86	.....
15.....	1	.....	.....	.....	.....	.....	13.77	.....	.....	.....	65.32	.....	2.55	.....
16.....	1	.....	4.59	13.77	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
17.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
18.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
19.....	3	4.22	7.36	4.59	9.40	.....	.....	7.96	.....	15.44	32.82	6.39	11.82	.....
20.....	2	.....	.....	5.70	.84	.....	.50	30.30	7.71	14.74	40.21	.....	.....	.....
21.....	2	2.65	2.64	8.92	20.50	.....	.....	.....	6.61	6.12	42.33	10.23	.....	.....
22.....	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
23.....	2	.....	16.83	3.81	11.03	.....	1.05	16.70	6.04	12.34	32.20	.....	.....	.....
24.....	3	.....	1.51	2.73	9.37	.....	1.82	30.79	2.73	4.84	33.43	10.88	1.90	.....
25.....	4	1.95	3.57	8.01	14.74	.....	14.06	18.83	1.35	1.95	23.94	9.55	2.02	.....
26.....	5	4.11	8.18	6.71	8.84	.....	7.80	22.56	4.24	.25	17.87	15.21	4.23	.....
27.....	3	4.66	6.64	12.96	8.05	1.85	17.07	13.10	4.22	4.08	19.06	3.38	4.93	.....
28.....	2	.....	4.61	3.99	6.52	.....	17.40	28.53	2.77	11.13	13.92	11.13	.....	.....
29.....	5	2.51	.26	2.98	8.43	.....	13.61	27.53	1.99	9.00	25.90	5.82	1.07	.90
30.....	2	10.97	7.47	5.26	5.94	.98	10.75	25.53	7.48	2.44	18.91	1.83	2.44	.....
31.....	2	.84	.....	6.11	7.73	.91	20.64	24.55	1.40	8.98	17.97	10.87	.....	.....
32.....	4	4.41	6.82	5.03	7.46	2.92	12.67	25.06	2.21	5.19	17.66	8.30	2.27	.....
33.....	2	2.18	3.75	7.86	10.34	.79	12.47	27.16	4.35	1.94	13.25	8.83	7.08	.....
34.....	2	3.28	7.72	4.74	12.59	2.43	13.93	29.12	2.67	5.83	11.19	5.53	.97	.....
35.....	3	.73	.....	4.40	19.03	.....	15.10	29.72	2.17	2.34	21.22	3.53	1.76	.....
36.....	1	.....	.....	.....	13.85	.....	.....	33.65	4.02	.....	28.70	.....	.....	.....
37.....	1	.....	.....	.....	13.85	.....	13.85	.....	.....	.....	.....	3.58	2.35	.....

TABLE 8
PER CENT GRADE RECOVERY—DRY LUMBER GRADE BASIS
PONDEROSA PINE—LOG GRADE 3

Diameter of log (inches)	No. of logs	Selects and better			Midng.	3 Ctr.	Shop			Common					
		B and better	C	D			1	2	3	1	2	3	4	5	
15	2	.....	.....	.....	.....	.....	.....	8.70	.....	7.82	83.48	.....	.....	.....	.....
16	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	73.10	.....	6.25	.....	.....
17	5	.48	.57	3.71	1.61	.....	2.00	9.78	8.65	14.93	38.70	15.58	2.47	1.52	.....
18	4	.....	1.22	.....	.67	.....	.....	11.31	3.35	3.59	48.47	31.03	.36	.....	.....
19	8	.....	1.48	2.91	2.08	1.34	1.15	8.40	2.40	2.96	46.62	25.53	5.13	.....	.....
20	11	.....	.34	1.78	2.21	.....	3.32	11.72	4.80	6.73	45.14	21.06	2.90	.....	.....
21	10	.44	.57	2.24	2.78	.....	4.96	22.88	5.56	9.11	22.87	24.11	3.82	.66	.....
22	6	.....	.94	1.50	4.54	.....	7.30	26.08	7.30	2.24	40.52	6.59	2.99	.....	.....
23	10	.....	1.71	3.44	8.65	.78	6.75	17.92	8.09	2.51	31.95	16.88	1.32	.....	.....
24	8	1.50	2.04	2.57	3.17	.72	7.48	29.58	6.35	8.39	24.94	9.55	3.71	.....	.....
25	7	2.36	2.93	2.84	7.62	.27	7.95	24.87	4.75	5.47	31.64	8.97	.33	.....	.....
26	6	.....	.63	2.89	7.22	.....	10.57	25.85	5.57	4.46	21.47	17.43	3.63	.28	.....
27	6	2.08	3.38	8.42	6.01	2.59	8.68	27.51	5.30	.....	13.43	13.03	9.57	.....	.....
28	4	.90	1.26	6.23	8.20	1.26	6.68	18.83	7.40	.49	40.50	6.95	.94	.36	.....
29	4	.....	.79	.79	3.18	1.27	9.79	32.25	9.32	6.35	29.72	5.71	.83	.....	.....
30	3	1.43	3.07	2.33	17.78	2.33	14.83	17.32	5.72	1.11	26.35	7.73	.....	.....	.....
31	3	.40	4.92	3.51	4.72	1.41	15.56	30.25	4.06	3.21	10.68	15.81	5.47	.....	.....
32	7	1.65	2.19	4.72	6.65	.90	13.11	32.23	8.78	3.25	14.98	8.92	2.62	.....	.....
33	3	2.62	3.70	4.42	8.82	1.00	9.57	33.57	1.71	.46	16.97	13.66	3.50	.....	.....
34	2	.....	.....	.59	7.34	.....	10.02	41.25	11.73	.....	13.26	14.86	.95	.....	.....
35	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
36	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
37	1	.....	.78	1.96	7.34	.....	34.53	28.30	3.13	.....	14.57	9.39	.....	.....	.....
38	1	.....	3.11	.58	17.34	.....	8.97	46.52	9.64	.....	.....	5.75	8.09	.....	.....
39	1	4.22	8.53	11.46	7.45	3.46	17.27	20.08	1.30	.....	18.03	5.72	2.48	.....	.....
40	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
41	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
42	1	1.86	5.31	16.65	17.73	.....	23.92	17.53	1.86	.....	7.08	3.81	4.25	.....	.....

TABLE 9
PER CENT GRADE RECOVERY—DRY LUMBER GRADE BASIS
SUGAR PINE—LOG GRADE 3

Diameter of log (inches)	No. of logs	Selects and better			Midng.	3 Ctr.	Shop			Common				
		B and better	C	D			1	2	3					
										1	2	3	4	5
15.....	1	.....	.....	13.21	.....	.....	.....	.....	17.61	.....	67.30	.....	1.88	.....
16.....	2	.....	2.83	12.60	2.06	.....	.....	.....	.....	.....	72.79	.....	9.72	.....
17.....	5	1.09	.....	2.86	8.00	.....	4.96	15.73	4.80	4.04	47.75	10.10	.67	.....
18.....	3	.....	2.95	.....	4.72	.....	3.99	5.91	12.26	22.89	42.55	4.73	.....	.....
19.....	8	.....	2.08	5.07	2.32	.....	.87	.....	12.13	6.32	38.00	17.69	1.30	.97
20.....	10	.....	3.42	3.69	4.26	.....	1.55	17.25	6.26	9.21	29.67	22.73	1.72	.24
21.....	11	.44	1.83	3.20	3.20	.....	2.17	32.59	4.56	5.87	29.73	10.23	6.18	.....
22.....	4	.....	1.22	2.56	4.30	.....	9.87	11.29	6.34	6.42	34.15	23.02	.58	.....
23.....	5	.....	.31	.83	.73	.....	3.85	38.75	7.50	4.16	34.55	8.33	.99	.....
24.....	13	.54	.98	2.66	3.65	.....	9.48	26.89	3.16	3.21	26.93	17.32	5.18	.....
25.....	12	.....	.23	2.51	3.81	.....	8.42	26.91	7.08	3.60	36.10	7.05	2.55	1.74
26.....	9	.....	.17	1.77	4.03	.52	14.62	30.32	3.94	4.25	31.55	5.66	3.17	.....
27.....	7	.....	2.23	5.22	2.09	.93	8.08	29.18	4.55	5.08	23.94	13.72	4.85	.13
28.....	8	.94	1.48	3.00	4.37	1.17	12.30	28.87	5.18	1.70	22.55	15.97	2.29	.18
29.....	8	.....	1.34	2.85	5.99	2.04	11.70	34.85	4.28	4.91	21.40	8.47	2.17	.....
30.....	8	.23	1.75	1.50	6.94	.....	7.06	35.10	7.16	3.00	29.13	6.97	1.08	.08
31.....	3	3.01	11.08	5.97	4.36	.....	12.65	27.31	4.52	1.72	12.65	4.51	11.31	.91
32.....	4	.....	.....	.75	2.48	.56	12.80	41.19	5.00	3.36	26.70	5.59	1.57	.....
33.....	2	.82	1.64	1.78	4.10	.89	9.16	32.81	9.63	.89	17.16	14.29	6.83	.....
34.....	..	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
35.....	..	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
36.....	..	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
37.....	1	4.67	11.03	.....	20.88	.....	6.26	27.68	2.87	.....	6.78	16.44	3.39	.....

TABLE 10
PER CENT GRADE RECOVERY—DRY LUMBER GRADE BASIS
PONDEROSA PINE—LOG GRADE 4

Diameter of log (inches)	No. of logs	Selects and better			Midg.	3 Ctr.	Shop			Common				
		B and better	C	D			1	2	3	1	2	3	4	5
12	2	.....	.....	.....	5.18	.....	.....	9.62	.....	29.63	55.57	.....	.....	.....
13	4	.....	.....	2.43	.....	.....	.....	.....	.....	.....	72.98	22.16	.....	2.43
14	2	.....	.....	.....	.....	.....	.....	2.85	.....	9.60	72.60	14.95	.....	.....
15	8	.....	.....	.....	.....	.....	.....	4.10	2.13	7.49	65.16	20.49	.63	.....
16	9	.....	.....	2.20	2.09	.....	.68	5.81	2.94	9.09	60.98	15.08	1.13	.....
17	8	.....	.64	3.42	1.68	.....	1.86	1.16	.....	3.43	51.60	24.32	10.67	1.22
18	8	.....	.58	1.43	1.54	.....	1.01	3.03	.27	3.40	55.77	31.17	1.80	.....
19	7	.....	.....	.59	1.12	.....	4.86	4.32	.85	12.70	55.02	17.18	2.40	.96
20	4	.....	.....	.....	1.03	.....	4.96	7.68	2.81	2.99	47.03	19.27	13.57	.66
21	1	.....	.....	.....	.....	.....	.....	.....	.....	23.18	38.41	27.17	11.24	.....
22	3	.....	.....	.74	2.60	.....	.....	14.85	1.31	5.94	39.76	33.87	.93	.....
23	2	.....	1.20	1.20	2.53	.....	12.12	25.23	4.52	.....	31.91	13.45	7.85	.....
24	3	.....	.....	3.77	3.05	.....	4.89	28.40	5.78	5.13	40.07	7.95	.96	.....
25	1	.....	.....	2.98	2.98	.....	.....	28.87	13.23	.....	39.65	9.87	2.42	.....
26	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
27	1	.....	.....	.....	.....	.....	7.97	25.12	10.15	.....	56.76	.....	.....	.....
28	1	.....	1.54	3.03	6.93	1.15	.....	23.07	7.36	.....	54.61	2.31	.....	.....
29	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
30	1	.....	1.50	1.90	7.61	.....	6.13	20.40	8.43	.....	37.01	13.07	3.95	.....

TABLE 11
PER CENT GRADE RECOVERY—DRY LUMBER GRADE BASIS
SUGAR PINE—LOG GRADE 4

Diameter of log (inches)	No. of logs	Selects and better			Midg.	3 Clr.	Shop			Common				
		B and better	C	D			1	2	3	1	2	3	4	5
12.....	1										47.22	43.53	4.63	4.62
13.....	4	1.97								5.44	62.54	30.05		
14.....	3							2.18	2.78	6.35	55.37	33.32		
15.....	7				1.31		1.31	2.62	2.29	8.88	68.83	12.15	2.86	.25
16.....	9				.43		.68	2.54	.99	3.98	62.80	27.02	1.37	.19
17.....	4		1.42	1.18				2.96			57.08	35.83	1.53	
18.....	15		.37	2.19	.69		.85	8.32	3.84	11.87	53.78	16.87	1.09	.13
19.....	9		.27	.41	.41		1.32	13.87	4.27	4.73	48.99	24.91	1.23	
20.....	6			1.17	.52		4.97	8.29	6.43	8.13	50.02	18.15	1.87	.45
21.....	5				.74		.50	18.11	7.87	3.97	51.64	16.18	.99	
22.....	4			.80	.36	.58		29.32	5.27	2.32	45.50	14.84	.79	.22
23.....	2			1.70			1.70	29.00	7.67	4.54	49.72	5.67		
24.....	4		3.25		1.57	.64	3.31	18.57	3.89	1.86	31.35	29.01	6.20	.35
25.....	2		3.84				16.57	16.99	2.96	3.51	35.09	21.04		
26.....	1		6.45						22.57		12.90	48.41	9.67	
27.....	1						2.06	21.45	4.75	6.60	32.57	31.33	1.24	
28.....	1				3.94		4.29	23.07	8.40		34.35	22.91	3.04	
29.....														
30.....														
31.....														
32.....														
33.....														
34.....														
35.....														
36.....														
37.....	1			5.05	6.36		16.07	35.64	7.27		6.47	6.47	15.66	1.01

TABLE 12
PER CENT GRADE RECOVERY—DRY LUMBER GRADE BASIS
PONDEROSA PINE—LOG GRADE 5

Diameter of log (inches)	No. of logs	Selects and better			Midg.	3 Clr.	Shop			Common				
		B and better	C	D			1	2	3	1	2	3	4	5
13	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	53.30	44.94	1.76	.....
14	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
15	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	61.92	36.73	1.35	.....
16	2	.....	.....	.....	.....	.....	.....	3.87	.....	.....	34.04	55.32	6.77	.....
17	4	.....	.....	.....	.....	.....	.....	6.66	.....	4.44	58.33	28.76	1.81	.....
18	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
19	2	.....	.....	.....	.....	.....	.....	.....	.....	6.00	70.00	21.19	2.06	.75
20	2	.....	.....	.....	4.39	.....	5.21	22.45	3.41	.....	30.38	23.91	10.25	.....
21	1	.....	.....	.....	2.22	.....	.....	7.78	4.44	.....	78.62	5.55	1.39	.....
22	1	.....	.....	.....	2.70	.....	2.95	.....	8.85	.....	49.64	31.44	4.42	.....
23	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
24	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
25	1	.....	.....	.....	5.43	.....	2.28	21.35	11.03	.....	5.61	28.90	25.40	.....
26	1	.....	.....	.....	.....	3.14	.....	14.75	7.86	.....	6.29	57.55	10.41	.....

TABLE 13
PER CENT GRADE RECOVERY—DRY LUMBER GRADE BASIS
SUGAR PINE—LOG GRADE 5

Diameter of log (inches)	No. of logs	Selects and better			Midg.	3 Clr.	Shop			Common				
		B and better	C	D			1	2	3	1	2	3	4	5
12.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	93.75	6.25	.....	.....
13.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	77.65	22.35	.....	.....
14.....	2	.....	.....	.....	.....	.....	.....	.....	5.24	.....	58.04	28.10	8.62	.....
15.....	3	.....	.....	.....	.....	.....	.....	.....	4.03	10.16	69.12	16.69	.....	.....
16.....	6	.....	.....	3.40	.....	.....	.....	1.55	.....	3.11	59.74	31.24	.48	.48
17.....	4	.....	.....	3.11	.....	.....	.....	7.95	1.27	.....	27.77	58.63	1.27	.....
18.....	4	.....	.....	.....	.....	.....	.....	1.04	.....	.....	35.45	60.50	3.01	.....
19.....	3	.....	.....	.....	.....	.....	.....	3.50	4.63	7.22	52.84	30.12	1.69	.....
20.....	1	.....	.....	.....	.....	.....	3.66	9.58	17.75	.....	9.01	60.00	.....	.....
21.....	1	.....	.....	.....	.....	.....	1.04	19.76	.....	.....	72.00	8.24	.....	.....
22.....	2	.....	.....	.....	.....	.....	.....	10.06	8.22	.....	29.22	50.81	.65	.....
23.....	1	.....	.....	.....	.....	.....	3.90	18.35	2.19	.....	7.82	56.49	11.25	.....

TABLE 14
LUMBER GRADE RECOVERY—PONDEROSA PINE

Log grade	Item	Selects and better			Midg.	3 Ctr.	Shop			Common				
		B and better	C	D			1	2	3	1	2	3	4	5
1	Volume*.....	3,648	6,644	5,974	6,408	239	1,603	3,829	1,396	277	4,160	3,170	1,743	210
	Per cent recovery	9.28	16.91	15.20	16.31	.61	4.08	9.74	3.55	.70	10.58	8.07	4.44	.53
2	Volume.....	1,053	1,267	1,859	2,576	285	1,919	3,872	1,211	554	4,207	2,331	793	121
	Per cent recovery	4.78	5.74	8.43	11.67	1.29	8.71	17.57	5.49	2.51	19.09	10.57	3.60	.55
3	Volume.....	475	1,043	1,906	3,322	412	4,753	12,676	3,122	1,954	13,726	6,893	1,579	53
	Per cent recovery	.91	2.01	3.67	6.40	.79	9.17	24.42	6.02	3.77	26.43	13.27	3.04	.10
4	Volume.....	.....	52	265	346	8	437	1,702	476	948	8,529	3,037	590	60
	Per cent recovery	.....	.32	1.61	2.10	.05	2.66	10.35	2.90	5.77	51.84	18.45	3.59	.36
5	Volume.....	.....	.....	.....	77	16	57	427	176	64	2,020	1,540	345	4
	Per cent recovery	.....	.....	.....	1.63	.34	1.21	9.04	3.71	1.35	42.77	32.57	7.30	.08

* All volumes are in board feet.

TABLE 15
LUMBER GRADE RECOVERY—SUGAR PINE

Log grade	Item	Selects and better			Mldng.	3 Ctr.	Shop			Common				
		B and better	C	D			1	2	3	1	2	3	4	5
1	Volume*	2,079	5,508	5,228	7,905	70	2,497	5,857	1,322	343	5,147	2,939	1,604	134
	Per cent recovery	5.11	13.54	12.85	19.45	.17	6.13	14.42	3.25	84	12.76	7.21	3.94	.33
2	Volume	735	1,152	1,506	2,786	198	3,175	6,514	848	1,464	5,983	2,054	685	27
	Per cent recovery	2.71	4.25	5.55	10.28	.73	11.73	24.05	3.13	5.40	22.06	7.58	2.53	.....
3	Volume	223	974	1,537	2,395	233	4,608	15,559	3,090	2,331	15,617	6,201	1,719	154
	Per cent recovery . . . . .	.41	1.78	2.81	4.38	.43	8.44	28.47	5.66	4.26	28.59	11.35	3.14	.28
4	Volume	10	26	315	196	19	597	2,822	1,003	1,124	10,122	4,531	544	43
	Per cent recovery . . . . .	.05	.12	1.47	.92	.09	2.79	13.22	4.70	5.27	47.44	21.19	2.54	.20
5	Volume . . . . .	.....	.....	62	.....	.....	37	360	222	149	2,799	2,725	134	5
	Per cent recovery . . . . .	.....	.....	.96	.....	.....	.57	5.54	3.42	2.30	43.07	42.00	2.06	.08

* All volumes are in board feet.

Ponderosa Pine Log Grade Descriptions as reworded on November 1, 1938
Pacific Northwest Forest and Range Experiment Station
Portland, Oregon

Grade 1

Shall be smooth and surface clear without indications of knots near the surface, providing, however, that 1 pin knot is permissible any place on the log.

Grade 2

Shall be smooth and surface clear on three faces but with knots permissible on the fourth face; or shall be smooth and surface clear on the lower three-fourths of the length, above which a few knots are permissible; or shall be smooth and surface clear to within 2 feet of the upper end, above which any number of knots are permissible. In any case 1 pin knot is permissible on the clear portion of the log.

Grade 3

Shall display knots which may vary from small black knots to large sound or unsound knots but which are spaced at least feet apart (longitudinally) when the knots are staggered or 6 feet apart when they are in solid whorls. The surface clear areas must aggregate at least 50 per cent of the total surface of the log, provided that each clear area must be at least 4 feet long by one-fourth the circumference in width.

Grade 4

Shall display numerous small and medium-sized red (live) knots, provided, however, that black (dead) knots which in the grader's judgment will cut out sound beneath the surface (usually on black barked logs) are permissible. The size of the knots shall be proportionate to the size of the log. For a 12-inch log 2-inch live or 1-inch dead knots and for a 24-inch log 4-inch live or 2-inch dead knots are permissible. An average longitudinal spacing of not less than 2 feet shall be required for logs with maximum knot sizes.

Grade 5

Shall display numerous live and/or dead knots, the maximum size of which shall be proportionate to the size of the log. For a 12-inch log, 4-inch live and 2-inch dead knots, and for a 24-inch log, 5-inch live and 3-inch dead knots, and for a 36-inch log, 6-inch live and 4-inch dead knots are permissible. An average longitudinal spacing of not less than 2 feet shall be required for logs with maximum knot sizes.

Logs with larger knots shall also be admitted to this grade if their surface clear areas aggregate at least one-third of the total surface of the log, provided that each clear area must be at least 3 feet long by one-fourth the circumference in width.

Grade 6

Shall be rough, coarse or densely knotted logs unsuited to any of the previous grades.

General Considerations

Foregoing specifications as to spacing between knots refer to distance between knot or limb edges rather than from center to center.

Defects for which deductions are made in scaling shall not be considered in determining log grades.

Standing trees shall be graded on the basis of 16-foot logs and each log shall be graded solely on the basis of its own grade characteristics, i.e., the grade characteristics of adjoining logs shall not be allowed to influence the grader's judgment.

